Mass.; Grand Haven, Lansing, Noble, and Pontiac, Mich.; Saint Vincent, Minn.; Hanover, N. H.; Beverly, Madison, Moorestown, and South Orange, N. J.; Garrettsville and Wauseon, Ohio; Chelsea, Vt. 31st, Webster, Dak.; Hampton, Iowa; Allison, Kans.; Mayfield, Me.; Traverse City, Mich.; Moorhead, Minn.; Hanover, N. H.

THUNDER-STORMS.

Thunder-storms were reported during the month, by states and territories, as follows: 1st, 18; 2d, 13; 3d, 1; 4th, 8; 5th, 8; 6th, 12; 7th, 5; 8th, 2; 9th, 7; 10th, 6; 11th, 4; 12th, 2; 14th, 7; 15th, 7; 16th, 12; 17th, 10; 18th, 14; 19th, 15; 20th, 6; 21st, 5; 22d, 3; 23d, 2; 24th, 1; 25th, 3; 26th, 10; 27th, 11; 28th, 2; 30th, 1; 31st, 9.

Thunder-storms were reported in the several states and territories, by days, as follows: Ala., 3; Ariz., 9; Ark., 4; Colo., 2; Conn., 3; Dak., 4; Fla., 8; Ga., 3; Ill., 13; Ind., 5; Ind. T., 4; Iowa, 12; Kans., 10; Ky., 2; La., 9; Me., 1; Md., 4; Mass., 4; Mich., 8; Minn., 1; Miss., 2; Mo., 7; Mont., 1; Nebr., 3; Nev., 1; N. H., 2; N. J., 4; N. Y., 5; N. C., 2; Ohio, 11; Oregon, 1; Pa., 7; S. C., 8; Tenn., 9; Tex., 11; Utah, 1; Vt., 1; Va., 5; Wash., 2; W. Va., 3; Wis., 8.

Thunder-storms were reported in the greatest number of states and territories (18) on the 1st. On the 2d, 6th, 16th to 19th, 26th, and 27th they were noted in from ten to fifteen. On the 13th and 29th no thunder-storms were reported, and on the 3d, 7th, 8th, 11th, 12th, 21st to 25th, 28th, and 30th they were reported in five or less states or territories.

They were reported on the greatest number of days (13) in Ill., with a total of 106 reporting stations. In Iowa (50 stations), Ohio (44 stations), Tex. (24 stations), and Kans. (40 stations) they were noted on from ten to thirteen days. In Cal., Del., D. C., Idaho, N. Mex., and R. I. no thunder-storms were reported, and in Ala., Ark., Colo., Conn., Dak., Ga., Ind., Ind. T., Ky., Me., Md., Mass., Minn., Miss., Mont., Nev., N. C., Oregon, Utah, Vt., Wash., and W. Va. they were noted on from one to five days.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Bismarck, Dak., 10th: The weather is very dry, and no rain has fallen since the 19th of last month.

Woonsocket, Dak., 31st: owing to the very dry weather plowing has been delayed to a greater extent than before during the last eight years.

Cedar Rapids, Iowa: the rainfall during the month has not been sufficient to keep the streams at their normal condition. Farmers in many places are complaining of lack of water in streams and wells.

FOREST AND PRAIRIE FIRES.

Jamestown, Dak., 4th: prairie fires were dangerously near Elbridge, ten miles west from here.

Bismarck, Dak., 9th: large prairie fires were observed several miles from this place; they were also observed to the south on the 29th and 30th.

Fort Totten, Dak., 9th: large prairie fires raged west of this place. A considerable amount of hay and grain and two farm houses were consumed. The fires moved southwest. Fires occurred on the 22d and spread rapidly over an area of seven miles northwest until they reached Devil's Lake.

Mandan, Dak., 11th: prairie fires, driven by a strong gale, threatened this town last night. The people turned out to fight the fire, and fire-breaks two hundred feet wide were made in all directions.

San Francisco, Cal., 24th: reports show that forest fires raged in Santa Cruz and San Joaquin counties, and that great damage was done to the fruit ranches and wheat.

Fort Sully, Dak., 28th: the whole western sky to an altitude of 30° was lighted up by prairie fires on the Sioux Indian reservation; prairie fires were also observed to the south and southwest of this station during the last four days of the month.

Fort Yates, Dak., 31st: one of the largest prairie fires ever known in this locality swept over the country opposite here, east of the Missouri River, in the evening. The town of Winona was only saved by the persevering efforts of its inhabitants.

Forest and prairie fires also occurred on the following dates: Fort Bidwell, Cal., 6th; Red Bluff, Cal., 14th, 24th; Fort Buford, Dak., 1st to 3d; Yankton, Dak., 30th; Fort Sill, Ind. T., 2d to 4th, 18th, 25th to 31st; Fort Assinaboine, Mont., 2d; Fort Elliott, Tex., 11th to 14th.

HALOS.

Solar halos were most frequently reported in Michigan and Tennessee, where they occurred on eight days. In Illinois, Oregon, and Pennsylvania they were noted on seven days, and in Maryland, New York, and Virginia on six days. No solar halos were reported in Connecticut, Delaware, District of Columbia, South Carolina, West Virginia, and Alabama, nor in the Rocky Mountain regions, except in Nevada and Montana, where they were noted on one and two days, respectively. In California a solar halo was observed on one day. The days of their most frequent occurrence were the 11th and 21st, when they were reported in ten states and territories; on the 22d, in nine; and on the 10th, in eight. On the 2d, 6th, 13th, and 28th no solar halos were reported.

Lunar halos were most frequently reported in Illinois, where they occurred on fourteen dates, in Michigan on ten, in Kansas on nine, and in Tennessee on eight. No lunar halos were reported in Alabama, Connecticut, Delaware, District of Columbia, Louisiana, and Rhode Island. In the plateau regions of the Rocky Mountains they were noted on from one to six dates, and on the Pacific coast on from four to seven dates. In the central valleys west of the Mississippi they occurred on from three to nine dates. They were most frequently reported on the 15th, when they occurred in sixteen states and territories; on the 17th, in fifteen; on the 18th, in thirteen; and on the 16th, in twelve. On the 1st, 2d, 3d, 5th, 6th, 7th, and 28th no lunar halos were reported.

METEORS.

The distribution of meteors, by dates, over the country was as follows:

3d, Fort Sully, Dak., Pekin, Ill. 4th, Kalamazoo, Mich., Clayton and Egg Harbor City, N. J. 6th, Fort Sully, Dak., Cedar Keys, Fla., Cedar Springs, S. C. 7th, Egg Harbor City, N. J., Marion, Va. 8th, Charleston, Ill., Fox Creek, Mo. 16th, Culbertson, Nebr. 17th, Vevay, Ind. 20th, Palestine, Ill., Cedar Springs, S. C. 25th, Pontiac, Mich. 26th, New Westminster, B. C., Strafford, Vt. 27th, Duck, Ga., Kalamazoo, Mich., Riddleton, Tenn., Mesquite, Tex. 28th, Egg Harbor City, N. J., Cleburne, Tex. 29th, Duke, Fla., Kalamazoo, Mich. 30th, Egg Harbor City, N. J., Utica, N. Y. 31st, Duke, Fla., Wakefield, Kans., Tecumseh, Nebr., Egg Harbor City, N. J., Fox Creek, Mo.

The following are additional and more notable meteoric displays reported:

Vevay, Switzerland Co., Ind.: a large meteor was observed at 5.55 p. m., 17th, at about 40° above the eastern horizon, and moving eastward; it was separated in a brilliant train which was visible eight or ten seconds.

Duck, Union Co., Ga.: a very brilliant meteor was observed at 11.15 p. m., 30th; it started in the east at an altitude of 45°, and moved in a southwesterly direction. The meteor was followed by a luminous trail which lasted about five seconds. Several small meteors were also observed during night of 30th.

MIRAGE.

San Diego, Cal.: the Lakeside hotel, trees, and a small

lake, distant twenty miles from this place, were distinctly seen on the 17th; the phenomenon lasted thirty minutes.

Mirage were also observed as follows: Yuma, Ariz., 3d, 10th; Fort Bidwell, Cal., 2d; San Diego, Cal., 17th; Webster, Dak., 2d, 3d, 5th, 6th, 8th, 13th, 29th; Woonsocket, Dak., 7th, 10th; Lake Forest, Ill., 30th; Hampton, Iowa, 10th, 11th; Marquette, Nebr., 4th, 8th, 29th to 31st; Green Bay, Wis., 7th.

SAND STORMS.

Sand storms were reported as follows:

San Carlos, Ariz., 18th, 19th; Dodge City, Kans., 18th, 31st; Keeler, Cal., 21st.

SUN SPOTS.

Sun spots were observed during the month as follows:

Mr. John W. James, Riley, McHenry Co., Ill.: reports that no sun spots were visible during the month.

Mr. H. D. Gowey, North Lewisburgh, Champaign Co., Ohio: the sun spots observed on the 25th were the only ones seen during the month.

Mr. M. A. Veeder, Lyons, Wayne Co., N. Y.: 2d, faculæ appeared by rotation; 24th, spots formed west of sun's meridian.

Prof. F. P. Leavenworth, director, Haverford College Observatory, Pa. (observed by Mr. H. V. Gummere, assistant):

Date. October, 1888.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculæ.		Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	
1, 4 p. m.	0	0	1	1	0	0	0	0	.....	.....	
2*	0	0	0	0	0	0	0	0	.....	.....	Through clouds.
3, 10 a. m.	1	1	0	0	1	1	1	1	.....	.....	
4, 3 p. m.	0	0	0	0	0	0	0	0	.....	.....	Definition very poor.
5, 4 p. m.	0	0	0	0	0	0	0	0	.....	.....	
8, 3 p. m.	0	0	0	0	0	0	0	0	.....	.....	
9, 9 a. m.	0	0	0	0	0	0	0	0	.....	.....	Definition poor.
10, 4 p. m.	0	0	0	0	0	0	0	0	.....	.....	
13, 11 a. m.	0	0	0	0	0	0	0	0	.....	.....	Definition good.
15, 9 a. m.	0	0	0	0	0	0	0	0	.....	.....	Definition poor.
16.	0	0	0	0	0	0	0	0	.....	.....	Do.
17, 9 a. m.	0	0	0	0	0	0	0	0	.....	.....	Definition good.
20, 9 a. m.	1	2	0	0	1	2	1	2	.....	.....	Definition very good; faint.
24, 10 a. m.	0	0	0	0	0	0	0	0	1	5	Definition poor.
25, 4 p. m.*	2	17	0	0	0	0	2	17	2	2	Definition very good.
29, 10 a. m.	0	0	0	0	0	0	1	3	0	0	Definition good.
30, 10 a. m.	0	0	0	0	0	0	1	1	0	0	Definition very poor.
31, 10 a. m.	0	0	1	1	0	0	0	0	0	0	Definition good.

*Observed by Prof. F. P. Leavenworth.

VERIFICATIONS.

INDICATIONS FOR 24 HOURS IN ADVANCE.

The percentages of verifications of the 8 p. m. daily indications for October, 1888, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for districts east of the Rocky Mountains for October, 1888, were made by Professor Cleveland Abbe, and those for the Pacific Coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Assistant Professor C. F. Marvin.

Percentages of indications verified, October, 1888.

States.		States.	
Maine	76.3	Tennessee	74.0
New Hampshire	75.8	Kentucky	76.9
Vermont	73.9	Ohio	67.0
Massachusetts	75.5	West Virginia	68.2
Rhode Island	77.4	Indiana	74.8
Connecticut	78.2	Illinois	75.1
Eastern New York	75.5	Lower Michigan	76.5
Western New York	73.0	Upper Michigan	74.5
Eastern Pennsylvania	74.6	Wisconsin	73.2
Western Pennsylvania	67.5	Minnesota	71.9
New Jersey	77.3	Iowa	74.4
Delaware	76.1	Kansas	71.7
Maryland	74.8	Nebraska	76.1
District of Columbia	77.0	Missouri	78.8
Virginia	78.0	Colorado	71.0
North Carolina	83.0	Eastern Dakota	74.2
South Carolina	85.7	Southern California*	93.7
Georgia	84.3	Northern California*	91.9
Eastern Florida	76.0	Oregon*	78.1
Western Florida	74.8	Washington Territory*	77.9
Alabama	80.6	*By elements:* Weather	80.5
Mississippi	78.1	Temperature	68.4
Louisiana	74.5		
Texas	77.3	Monthly percentage of weather and temperature combined†	75.7
Arkansas	78.8		

*In determining the general percentage for the different elements the Pacific coast states are not included. †The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

CAUTIONARY SIGNALS FOR OCTOBER, 1888.

Statement showing percentages of justifications of wind signals and cold-wave signals for the month of October, 1888:

Wind signals.—Total number of signals ordered, one hundred and seventy-three. Number of cautionary signals ordered, one hundred and sixty-nine; justified, wholly or in part, ninety. Number of storm signals ordered, four; justified, three. Number of signals ordered for easterly winds, eighty-four; justified, seventy-eight. Number of signals ordered for westerly winds, eighty-nine; justified, seventy-nine. Number of signals ordered late, ten. Number of storms without signals, twenty-three. Percentage of justifications, 62.3.

Cold-wave signals.—Total number of signals ordered, one hundred and thirty-two; justified, wholly or in part, forty. Number of severe cold-waves without signals, twelve. Percentage of justifications, 27.4.

LOCAL VERIFICATIONS.

The following extracts from the published reports of the state weather services for October, 1888, show the percentages of verifications of weather and temperature signals:

Nebraska.—The percentages of correct predictions for the state were: temperature, 89.7; weather, 82.1; mean, 85.9.

Ohio.—The percentages of verifications of weather signals (received from Washington and distributed to thirty-two stations) were: weather, 75; temperature, 80.

South Carolina.—The percentages of verifications for the state were: weather, 86.5; temperature, 84.5.

Tennessee.—The percentages of verifications of weather and temperature predictions for the month at the following stations were: Jonesborough, weather, 90.0; temperature, 96.3. Clarksville, weather, 85.2; temperature, 63.0. Pulaski, weather, 80.0; temperature, 80.0. Burkesville, weather, 92.0; temperature, 100.0.

STATE WEATHER SERVICES.

[*Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.*]

The following extracts are republished from reports for October, 1888, of the directors of the various state weather services:

ALABAMA.

From the 1st to the 13th the sky was overcast with heavy clouds and the weather was generally threatening, with high temperature, and low pressure. The second period of low pressure, from the 19th to the 26th, produced heavy rains over the entire state, with correspondingly high temperature. The clear and fair days of the month generally occurred on those days when high pressure waves were crossing the state.

The average temperature was 5.5 below the normal. The average precipitation was 1.29 above the normal. The month was generally mild with but few cool days, and the frosts that occurred were light.